CLAIMS

What is claimed is:

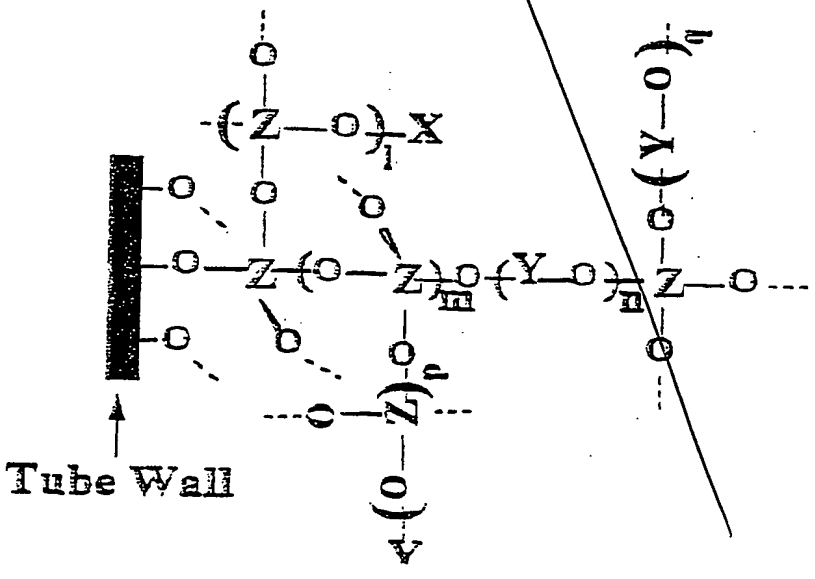
1. A capillary column comprising:

a. a tube structure, and

b. a deactivated surface-bonded sol-gel coating on a portion of the tube structure to form a stationary phase coating on that portion of the tube structure,

said deactivated stationary-phase sol-gel coating enabling separation of analytes while minimizing adsorption of analytes on the sol-gel coated tube structure.

2. A capillary column as set forth in claim 1, wherein said deactivated surface-bonded sol-gel-coating on the portion of the tube structure has the formula:



wherein,

X = Residual of a deactivation reagent;

Y = Sol-gel reaction residual of a sol-gel-active organic molecule;

Z = Sol-gel precursor-forming element;

l = An integer ≥ 0;

m = An integer ≥ 0;

n = An integer ≥ 0;

p = An integer ≥ 0;

q = An integer ≥ 0;

and

l, m, n, p, and q are not simultaneously zero.

Dotted lines indicate the continuation of the chemical structure with X, Y, Z, or Hydrogen (H) in space.

3. A capillary column as in claim 2 wherein the residual of the deactivation reagent is selected from the group including polymethylhydrosiloxane and hexamethyldisilazane.

4. A capillary column as in claim 2 wherein said sol-gel reaction residual is selected from the group including molecules with hydroxysilane or alkoxysilane functional groups or a combination thereof, either polymers or monomers, such as polydimethylsiloxane (PDMS),

polymethylphenylsiloxane (PMPS), polydimethyldiphenylsiloxane (PDMDPS), polyethylene glycol (PEG) and related polymers like Carbowax 20M, polyalkylene glycol such as Ucon, macrocyclic molecules like cyclodextrins, crown ethers, calixarenes, alkyl moieties like octadecyl, and octyl.

5. A capillary column as in claim 2 wherein said sol-gel precursor forming element is selected from the group including Si, Al, Ti, and Zr.

6. A method of preparing a capillary column comprising the steps of:

a. providing as tube structure;

b. providing a sol-gel solution comprising:

i. a sol-gel precursor,

ii. an organic material with at least one sol-gel active functional group,

iii. a sol-gel catalyst,

iv. a deactivation reagent, and

v. a solvent system;

c. reacting at least a portion of the tube structure with the sol-gel solution under controlled conditions to produce as surface-bonded sol-gel coating on the portion of the tube structure;

d. expelling the sol-gel solution from the portion of the tube structure; and

e. heating the coated portion of the tube structure under controlled conditions to cause the deactivation reagent to react with the surface-bonded sol-gel coating to deactivate and to condition the sol-gel coated portion of the tube structure.

7. A method as set forth in claim 6, including the step of hydrothermally pretreating the tube structure before reacting the portion of the tube structure with the sol-gel solution.

8. A method as set forth in claim 7, wherein the step of providing the tube structure comprises providing a tube structure with an inner wall, reacting the sol-gel solution with the inner wall of the tube structure for a period less than 1 hour to form a surface-bonded sol-gel coating on the inner wall of the tube structure, and then applying gas pressure to the sol-gel solution in the tube structure to expel the sol-gel solution from the tube structure.

9. A method as set forth in claim 8, wherein the sol-gel precursor comprises an alkoxy compound, the organic material comprises monomeric or polymeric material with at least one sol-gel active functional group, the sol-gel catalyst is taken from a group consisting of an acid, a base and a fluoride compound, and the deactivation reagent comprises a material reactive to hydroxyl groups bonded to the sol-gel precursor forming element or to the tube wall surface.

10. A method of preparing a capillary column by simultaneously deactivating, coating and immobilizing a stationary phase on a tube structure.

11. A method as set forth in claim 10 further defined as chemically bonding stationary phase molecules to an interfacial organic-inorganic polymer layer, the polymer layer evolving over a surface of the tube structure.